REMARKS

The applicants are grateful for the courteous interview and helpful oral argument accorded their attorney on 9 January 2007, in which details of the teachings of each of the references were discussed, and the merits of the claims argued. A record of the interview has been placed in the file of the application.

The amendment in the specification referring to the use of the expression "powder metal mixture" is made to correct an obvious oversight. The expression was used to define a powder metal mixture in general terms. The expression was inadvertently confused with the term "ferrous metal powder". Because a powder metal mixture typically includes alloying metals, lubricant, binder and other ingredients, as stated, the term was meant to state that "powder metal mixture" refers to a mixture of ferrous metal powder in which *mixture the ferrous metal powder* is present in an amount greater than 90 per cent, the remaining being other ingredients. That this was an inadvertent error will be evident from the definition of "ferrous metal powder" in the specification, at page 4, lines 12 – 14, stating:
"By "ferrous" metal powder is meant one in which the metal particles contain predominantly the element iron (Fe), typically at least 75% Fe."

Claims 1 and 11 have been amended to identify the components as suggested in the office action, so that the identifying letters (i) and (ii) are not duplicated. The letter "(a)" is used instead of "(i)" to identify a lubricant powder; and the letter "(b)" is used instead of "(ii)" to identify the starch particles.

In Claim 9 the duplicate and unnecessary use of the identifying letter "(i)" for the Hall flow rate, has been deleted to avoid confusion.

In each of the claims, the term "lubricant" was used to connote any conventional lubricant. Additionally qualifying the term "lubricant" as a "conventional lubricant", was originally done to emphasize that the lubricant "(a)" referred to in the claims is a conventional lubricant powder. Upon reviewing the claims in light of the office action it is evident that there is no need to use the term "conventional" with "lubricant" since it is clear that the lubricant is a conventional lubricant such as zinc stearate specified in claim

2. Therefore the expression "conventional lubricant" has been substituted with the previously used expression "lubricant powder".

Claims 5 and 9 have been amended – the expression "preferably from 1 : 1 to 4 :1" which was inadvertently overlooked in these claims, along with the comma preceding the expression, have been deleted.

Claims 6, 7 and 8 have been amended to further limit the parent claim.

The coined term "starchlube" has been used in the claims. The term is defined to be synonymous with the expression "modified lubricant". To ensure that there is no mis-understanding about the equivalence of the terms, it has been inserted in claims 1 and 5.

The numbered paragraphs of the office action are addressed *seriatim*, referring to those numbers in the following remarks.

It is recognized that the rejections of record are directed to the prior claims and not to the claims as now amended. The following comments, considerations and arguments relating to the rejections, are set forth in light of the claims as amended.

1. The rejection of claims 5, 6-9 under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention, is respectfully traversed.

Claims 5 and 9 have been amended by deleting the offending expression which was inadvertently overlooked. Since the claims 6, 7 and 8 as amended, now further limit the parent claim, the rejection is now moot.

Note that the claim includes the phrase "the modified lubricant being present in an amount less than 2% by weight of the composition,".

Note further that this phrase is preceded by the definition of the composition with the specific phrase "consisting essentially of". This requirement in the preamble of the claim necessarily means that there is always some modified lubricant present, or the composition would not "consist essentially of". Moreover, it is beyond argument that one

skilled in the art will recognize that *if there is no modified lubricant present*, there is nothing to distinguish the claimed composition from any other powder metal mixture.

Note still further than claim 5 specifies a preferred amount to be used.

3. The rejection of claims 1-2, 9, 11, and 12 under 35 U.S.C. 103(a) as being unpatentable over Engstrom (U.S. Patent No. 4,483,905) in view of Hoganas-Billesholms Aktiebolag (GB 1,162,702) is respectfully traversed.

It is acknowledged that Engstrom discloses homogenous iron based powder mixtures free of segregation comprising particles of iron or steel, particles of an alloying element and powder containing binding agent in solid state, and that the binder is added to eliminate segregation/dusting.

However, the office action did not note how the solid binder was used in the Engstrom powder metal mixture. Engstrom states: "When a solid binder is used it can be dissolved in a solvent which is evaporated after the mixing operation. Alternatively the properties of the solid binder can be chosen in such a way that the binder melts during the mixing operation and is then distributed in the mixture in liquid state." (see col 2, lines 31 – 37).

As noted in the office action, the binding agent is used in combination with a lubricant. With respect to the binding agent Engstrom specifically states:

> "According to the invention it is proposed to use binding agents with a *sticky or fat character* and the properties of which are such that they do not evaporate or change chemically with time at normal temperatures. It has been proved that binding agents of this nature can stand the internal forces that might arise when the powder mixture is handled. Binding agents, *which harden* with time, however, will give *cause to hard and brittle bridges* between the different particles which have proved not to be able to withstand these forces.
>
> In order to distribute the binding agent homogeneously in the powder mixture it is preferred to use binding agents with *good wetting properties*. When a *solid binder is used it can be dissolved in a solvent* which is evaporated after the mixing operation. Alternatively the properties of the solid binder can be chosen in such a way that the *binder melts during the mixing operation* and is then *distributed in the mixture in liquid state*." (see col 2, lines 18 – 32)."

Is it not amply clear that Engstrom wants a liquid binder?

The office action acknowledges that Engstrom differs from the claims in that Engstrom does not teach employing (a) starch as the binder and (b) the particle size of starch particle, but the office action does not state why one skilled in the art would look to Engstrom for a binder which was not sticky or fatty. The Hall flow rate is specified to emphasize that the powder metal mixture is free-flowing. A free-flowing powder would be contraindicated if the starch dispersed in the powder was sticky. As for "fatty", it is a fact that starch is not a fat.

Particularly since Engstrom states that if the binder hardens with time it would not serve its purpose, why would one use a solid binder? A solid binder is clearly contraindicated. In any event, of all the solid binders that might be used in a ferrous metal powder mixture, the office action provides no reason why one would be directed to use starch.

With respect to the flow rates given in Engstrom, note there is no indication as to how it is measured. It is evidently *not a Hall flow rate* (or it would have said so) so it is not known what diameter orifice was used to measure the flow. The Hall flow rate is clearly a defining characteristic of the powder metal mixture of claim 1.

It is acknowledged that with respect to part (a) of claim 1, GB '702 teaches a binder such as polyvinyl alcohol, starch and gum which is added to iron based powder to reduce loss of the material through dusting. The entire disclosure relating to the use of "small quantities of binder" is limited to the statement "Small quantities of binder such as polyvinyl alcohol, gum or starch, may also be added to iron based powder to reduce the loss material through dusting." Since polyvinyl alcohol and gum (such as commonly used xanthan, guar, and locust bean gum) are in a liquid state when used as binders, it is only reasonable to assume that the starch would also be in liquid state, not as a powder which would only aggravate the dusting problem. Note that though GB '702 provides an illustrative example of a powder metal mixture and states its characteristics, the example makes no mention of using any binder, whether polyvinyl alcohol, gum or starch.

The office action concludes "therefore (GB '702) teaches powder mixture that is free of segregation." It is respectfully submitted that there is no basis stated for arriving at this conclusion. The basis appears to be that a powder in which dusting is reduced must also be free of segregation. No reference is cited to justify this conclusion, and it is respectfully requested that such reference be provided.

It is conceded that if enough liquid binder was added to the powder metal mixture of GB '702, it would indeed be less dusty, but there is no scientific basis for believing the wetted mixture would be free of segregation.

Practical experience, if nothing else, teaches that there are numerous mixtures in which dusting may be reduced but which are nevertheless far from being homogeneous, therefore segregated to a greater or lesser degree. For example, a truck-mounted scarifier which grinds up an old, uneven and pot-holed road surface, whether asphalt or concrete, produces a large amount of dust while the road surface is being ground by a rotary cutting head. A water spray is typically directed on the cutting head. As the ground material is conveyed into a truck, dust settles to the road surface while the rest of the comminuted old road surface is conveyed on a conveyor belt feeding into the truck. Though the aggregate delivered into the truck is greatly reduced in dust, it is nevertheless far from homogeneous, therefore it is still segregated.

Referring further to the disclosure "Small quantities of a binder such as polyvinyl alcohol, gum or starch, . . . through dusting.", a straightforward reading would give one skilled in the art to understand that starch (as used in GB '702) is equivalent to polyvinyl alcohol and gum *only to the extent* that it (starch) provides the equivalent function of reducing dusting. The question is: "Why would one skilled in the art consider adding solid particulate starch particles having an average equivalent diameter less than 150 μm," which are so small as to obviously aggravate the dusting problem, to a powder metal mixture in which one wishes to reduce the dust?

More importantly, despite the casual reference (in GB '702) to the use of starch as a binder, since this is a solid binder which is contraindicated in Engstrom why would one skilled in the art even consider using it?

The office action acknowledges that Engstrom does not refer to starch being used as a binder. Obviously therefore, he could not refer to either the particle size or the

amount which might be used. The reason the office action uses the Engstrom reference is to document the fact that certain binding agents are used to eliminate segregation; and, a lubricant such as zinc stearate is added to facilitate pressing the powder metal mixture in a die. As the office action recognizes, the problem Engstrom addressed was segregation of the components of his powder metal mixture. It is evident from the complete disclosure of Engstrom that he successfully solved this problem.

Note however, Engstrom unequivocally states: "As the binder should be active in the powder mixture until after the compaction it is not allowed to affect the characteristic physical powder properties of the mixture such as apparent density, flow, compressibility and green strength." (see '905, col 2, lines 47 – 51). The applicants' powder metal mixture on the other hand may decrease the apparent density of the powder metal mixture, but not appreciably; and the Hall flow rate is maintained in the specified range of from about 25 - 40 sec/ 50 g irrespective of what the flow rate was without the starch particles.

Granted the foregoing, the office action does not state why one skilled in the art, upon reading the disclosure of Engstrom, would be motivated to look to any other reference to solve a problem not contemplated by him.

Referring specifically to amended claim 1, it requires "starch particles having an average equivalent diameter less than 150 μm, the modified lubricant being present in an amount less than 2% by weight of the composition," It is evident that this limitation is the key to solving the problem applicant has addressed and Engstrom has no reason to use starch.

Still further, neither Engstrom nor GB '702 refers to the problem created by adding too much lubricant of any kind. Applicants' invention requires that the modified lubricant be present in an amount less than 2% by weight of the composition or the benefits provided by the lubricant will be vitiated.

Referring specifically to claim 9, note that it requires "starch particles having an average equivalent diameter less than 150 μm present in an amount from about 0.25% to less than 0.75% by weight of the mixture," which is not only specific with respect to the size of the particles but also with respect to the amount which may be

present. One skilled in the art will appreciate that it is these limitations which result in the "mixture having a Hall apparent density numerically no smaller than 10% less than that obtained for the same powder metal mixture made with the conventional lubricant without the starch particles" as stated in the amended claim.

It is acknowledged that with respect to part (b) of claim 1, Engstrom teaches using an iron-based powder in a size substantially below 147 microns (col. 4, lines 11-14) and an alloying powder having maximum particle size of 44 microns, (col. 3, lines 17-19).

The office action states that Engstrom is silent about the size of the solid binder. As will be surmised from the discussion of Engstrom above, he is silent about the size of the solid binder, because for him, the size is immaterial. He clearly specifies that if a solid binder is used, that it be *dissolved* - size is immaterial.

Though it is acknowledged that it is generally desirable to have binder particles smaller than the metal particles in a powder metal mixture, the statement that "it is conventionally well known in the art that binding agent used to bind particles of powder together should be in a size smaller than the size of the powder being bonded to facilitate homogeneous mixing." is not substantiated. For example particles of stearic acid and some waxes which are larger than the metal particles in a mixture, are believed to liquefy under pressure of compaction so that their initial size is not narrowly critical. Note also, as stated in the specification, some mixes are heated to prepare a homogeneous mixture (see specification, page 6, lines 8 – 12).

Since, as the office action concedes, Engstrom does not mention starch, the basis for the conclusion in the office action, that "it would have been obvious to one skilled in the art to use starch particle as taught by Engstrom in view of GB '702 in a size less than the size of the smallest powder, i.e., less than 44 microns", is not substantiated.

With respect to claim 2, zinc stearate is a metal soap. Not only is Engstrom silent about lubricants other than zinc stearate, there is no indication that zinc stearate might be substituted with *any other* lubricant. Given the requirement that his binder is a liquid which is sticky or fatty, why would one be led to use some unidentified solid powder

lubricant?

Surely the office action does not suggest that, just because it is well known to add a lubricant to a powder ferrous metal mixture, it is obvious that zinc stearate could be substituted with a specific lubricant selected from fatty acid monoamides, fatty acid bisamides, metal soaps and polyolefin waxes.

Referring further to claim 2, note that the specification states:

"Addition of starch particles in an amount as little as 2% by wt of the total powder mixture, whether of a water-soluble starch or a water-insoluble starch, having an average diameter no smaller than 50 μm, though in the same size range as the avg. equiv. diam. of metal particles used in a compactable powder mixture, results in both unacceptable bulk or apparent density as well as flow characteristics, if the mixture is to be used in the mass production of compacted and sintered parts. The poor physical properties of a powder metal mixture containing starch particles 50 μm and larger is attributable to the volume the particles occupy and the irregularity of their individual shapes." (see page 5, lines 11 – 19).

It is evident from the foregoing that starch particles no smaller than 50 μm are unsuited for mass production of compacted sintered parts. No combination of teachings of the references could lead one to learn of such a limitation.

With respect to the recitation in claim 9, fragmented cellulose fibers present in an amount of from 0 to less than 0.75, specifies that the cellulose fibers are optional. As pointed out above with reference to claim 1, the powder mixture defined therein is distinguished over that of Engstrom in view of GB '702.

The essential element of claim 9 is set forth right at the outset, namely that the the mixture must have a Hall flow rate in the range from about 25 – 40 sec/ 50 g of mixture. The statement of a flow rate in Engstrom without stating it is a Hall flow rate, or defining how it is derived, is *prima facie* indefinite. Engstrom fails, *inter alia,* to meet the key criterion of flow rate. Moreover, since he specifies using a sticky or fatty binder there is no reason to believe the powder metal mixture is free-flowing. Therefore it is unlikely that the stated flow rate is a Hall flow rate, or derived in a manner equivalent to a Hall flow rate.

Not only must the starch particles be present, but with respect to (b) of claim 9 the starch particles have an average equivalent diameter less than 150 μm, and they are present in a specified amount, namely from about 0.25% to less than 0.75% by weight of the mixture. There is no suggestion for this further limitation of starch particles suggested in GB '702, and no mention of the size of binder particles in Engstrom (for the reason stated above).

It is well-settled law that the entire body of evidence, and that provided by the applicant, must be weighed in the first instance by the U.S.P.T.O.; and that, (a) the combination of references cited in the rejection must suggest or expressly imply the possibility of achieving further improvement by combining relevant teachings along the lines of the invention claimed, and (b) the claimed invention achieves more than a combination suggested by the references, expressly or by reasonable implication. *See **In re Sernaker***, 702 F.2d 989, 217 USPQ 1 (Fed. Cir. 1983).

It is respectfully suggested that the conclusion arrived at in the office action, namely that "it would have been obvious to one of ordinary skill in the art to use starch particle as taught by Engstrom in view of GB '702 in the size less than the size of the smallest powder, i.e. less than 44 microns" is inadequately substantiated.

In view of the foregoing remarks, arguments, and amendments to the specification and the claims, it is respectfully submitted that the basis for the rejections have been overcome and that the claims are in condition for allowance.

Respectfully submitted,

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